XXXII. *Account of a Comet.* *By Mr.* Herſchel, *F. R. S.*; *communicated by Dr.* Watſon, *Jun. of* Bath, *F. R. S.*

Read April 26, 1781.

ON Tueſday the 13th of March, between ten and eleven in the evening, while I was examining the ſmall ſtars in the neighbourhood of H Geminorum, I perceived one that appeared viſibly larger than the reſt: being ſtruck with its uncommon magnitude, I compared it to H Geminorum and the ſmall ſtar in the quartile between Auriga and Gemini, and finding it ſo much larger than either of them, ſuſpected it to be a comet.

I was then engaged in a ſeries of obſervations on the parallax of the fixed ſtars, which I hope ſoon to have the honour of laying before the Royal Society; and thoſe obſervations requiring very high powers, I had ready at hand the ſeveral magnifiers of 227, 460, 932, 1536, 2010, &c. all which I have ſucceſsfully uſed upon that occaſion. The power I had on when I firſt ſaw the comet was 227. From experience I knew that the diameters of the fixed ſtars are not proportionally magnified with higher powers, as the planets are; therefore I now put on the powers of 460 and 932, and found the diameter of the comet increaſed in proportion to the power, as it ought to be, on a ſuppoſition of its not being a fixed ſtar, while the diameters of the ſtars to which I compared it were not increaſed in in the ſame ratio. Moreover, the comet being magnified much beyond what its light would admit of, appeared hazy and ill-defined with theſe great powers, while the ſtars preſerved that luſtre and diſtinctneſs which from many thouſand obſervations I knew they would retain. The ſequel has ſhewn that my ſurmiſes were well founded, this proving to be the Comet we have lately obſerved.

I have reduced all my obſervations upon this Comet to the following tables. The firſt contains the meaſures of the gradual increaſe of the Comet's diameter. The micrometers I uſed, when every circumſtance is favourable, will meaſure extremely ſmall angles, ſuch as do not exceed a few ſeconds, true to 6, 8, or 10 thirds at moſt; and in the worſt ſituations true to 20 or 30 thirds: I have therefore given the meaſures of the Comet's diameter in ſeconds and thirds. And the parts of my micrometer being thus reduced, I have alſo given all the reſt of the meaſures in the ſame manner; though in large diſtances, ſuch as one, two, or three minutes, ſo great an exactneſs, for ſeveral reaſons, is not pretended to.

TABLE I. Meaſures of the Comet's diameter [*].

Days.	″	‴	Powers.
March 17	2	53	932. 460.
19	2	59	932. 460.
21	3	38	460.
28	4	7	932 } theſe meaſures agree to 9‴.
—	3	58	227
29	4	7	227 rather too ſmall a meaſure.
—	4	25	227 ſeems right.
April 2	4	25	227
6	4	53	227
15	5	11	227
—	5	20	227 very good; not liable to half a ſecond of error.
18	5	2	227 true to 12‴ or 18‴ at moſt.

Having meaſured the diameter of the Comet with ſuch high power as 932 and 460, it may not be amiſs to make one obſervation on this ſubject, leſt it ſhould be miſapprehended that I pretend to a diſtinct power of ſuch magnitude upon all celeſtial objects in general. By experience I have found, that the aberration or indiſtinctneſs occaſioned by magnifying much, provided the object be ſtill left ſufficiently diſtinct, is rather to be put up with, than the power to be reduced, when the angles to be meaſured are extremely ſmall. The reaſon of this may, perhaps, be that a ſmall error of judgement, to which we are always liable, is of great conſequence with a low power, as bearing a conſiderable proportion to the diameter of the object;

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[*] There are ſeveral optical deceptions which may affect the meaſures of objects that ſubtend extremely ſmall angles. Thus I have found, by experience, that a very ſmall object will appear ſomething leſs in a teleſcope when we ſee it firſt than when we become familiar with it. There is alſo a deflection of light upon the wires when they are nearly ſhut; but as none of theſe deceptions are well enough underſtood to apply a correction, I leave them affected with them.

whereas with a higher power the proportion of this error to the whole becomes much leſs, and the meaſure more exact, even after we have made allowance for a ſmall additional error occaſioned by the want of that perfect diſtinctneſs which is required for other purpoſes. However, to enter deeply into an explanation of this would lead me to ſpeak of the cauſes of the aberration of rays in the focus of an object ſpeculum, of which there are ſome that are ſeldom taken into conſideration by opticians, and indeed are ſuch as cannot be calculated; but this not being my preſent purpoſe, ſuffice it to obſerve, that the method is juſtified by experience.

When the diameter of the Comet was increaſed to about $4''$, I thought it adviſable to leſſen the power with which I meaſured; and, as I made uſe of two different micrometers, as well as eye-glaſſes, I took a meaſure with both of them. The agreement of the micrometers to $9'''$ is no ſmall proof of the goodneſs of the obſervations of the 28th of March, and very properly connects the meaſures of the high powers with thoſe that were made with 227.

TABLE II. Diſtance of the Comet from certain teleſcopic fixed ſtars which I have marked α, β, γ, δ, ε, ζ.

D.	H.	M.		′	″	‴	
Mar. 13	10	30	from α,	2	48	0	by pretty exact eſtimation true to 20″.
17	11	0	fig. 1*.	0	41	58	by the micrometer and power 227.
18	7	20		1	0	35	
—	9	16		1	6	59	
—	10	55		1	10	40	
19	7	4		1	46	40	
—	10	42		1	51	23	
21	10	0		3	39	46	
24	8	12	from β,	2	55	39	true to 4 or 5″, an indifferent obſervation.
—	10	58	fig. 2.	2	53	4	true to 4 or 5″.
25	7	24		2	12	46	true to 2 or 3″.
—	9	47		2	14	18	
26	10	43		1	48	3	true to 2 or 3″.
28	7	46		2	55	49	true to 4 or 5″.
29	8	50	from γ.	2	20	51	true to 2″.
30	7	55	fig. 3.	1	28	48	true to 2 or 3″.
Apr. 1	7	45		2	39	20	
6	8	50	from δ. fig. 4.	2	51	23	
15	10	18	from ε.	4	27	57	eſtimated by the field, true to 5 or 6″.
16	7	50	fig. 5.	3	9	14	by the micrometer, true to 3 or 4″.
—	10	47		2	50	56	true to 3 or 4″.
18	8	18		3	18	4	mean 3′ 17″, true to 1″ or 1½.
—	—	—		3	15	57	
—	8	50	from ζ,	2	24	57	
19	8	38	fig. 6.	3	2	5	true to 3 or 4″.

* The figures are drawn upon a ſcale of 80 ſeconds to one inch.

TABLE III. Angle of poſition of the Comet with regard to the parallel of declination of the ſame teleſcopic fixed ſtars meaſured by a micrometer, of which I have given the deſcription, and a magnifying power of 278. See fig. 1. 2. 3. 4. 5. 6.

D.	H.	M.		°	′	
Mar. 13	10	30	Bα Comet,	0	0	by ſuperficial eſtimation, liable to an error of 10 or 12 degrees.
17	11	0	Aα Comet,	89	56	by the micrometer.
18	8	20	fig. 1 *.	56	39	
—	9	24		41	33	true to 1°.
19	7	23		29	47	true to 1°.
21	10	10		11	46	true to 4 or 5°.
—	11	48		12	14	
24	8	23	Bβ Comet,	38	39	true to 2 or 3°.
—	11	4	fig. 2.	36	14	true to 3 or 4°, air very tremulous.
25	7	33		53	18	
—	9	55		56	32	liable to a conſiderable error.
26	10	55	Aβ Comet.	87	0	true to 2 or 3°.
28	7	58		28	51	true to 3 or 4°.
29	9	25	Bγ Comet,	32	19	true to 1 or 2°.
30	8	25	fig. 3.	72	14	true to 3 or 4°.
Apr. 1	7	55	Aγ Comet,	28	51	well taken, } 27° 46′, true to 1°.
—	—	—		27	14	more exact,
6	8	28	Bδ Comet, fig. 4.	84	42	true to leſs than 2°
15	10	27	Bι Comet,	29	9	true to 2 or 3°.
16	8	1	fig. 5.	49	11	true to 1°.
—	10	55		50	47	true to 1½ or 2°½.
18	8	31	Aι Comet,	47	9	very well taken, } 47°, true to leſs than 1°.
—	—	—		46	35	pretty well,
—	9	8	Bζ Comet,	82	39	
19	8	56	Aζ Comet,	48	18	} 49° 3′, true to 1°.
—	—	—	fig. 6.	49	48	
—	10	45		47	30	true to 2 or 3°.

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* The angles are drawn true to the meaſure, without allowing for errors.

Miſcellaneous obſervations and remarks.

March 19. The Comet's apparent motion is at preſent $2\frac{1}{4}$ ſeconds *per* hour. It moves according to the order of the ſigns, and its orbit declines but very little from the ecliptic.

March 25. The apparent motion of the Comet is accelerating, and its apparent diameter ſeems to be increaſing.

March 28. The diameter is certainly increaſed, from which we may conclude that the Comet approaches to us.

April 2. This evening at 8 h. 15′ the Comet was a little above the line drawn from η to θ in fig. 7. This figure is only delineated by the eye, ſo that no very great exactneſs in the diſtances of the ſtars is to be expected; but I ſhall take the firſt opportunity of meaſuring their reſpective ſituations by the micrometer.

April 6. With a magnifying power of 278 times the Comet appeared perfectly ſharp upon the edges, and extremely well defined, without the leaſt appearance of any beard or tail.

April 16. Fig. 8. repreſents the ſituation of the Comet this evening about nine o'clock, and is only an eye-draught of the teleſcopic ſtars.

Remarks on the path of the Comet.

We may obſerve, that the method of tracing out the path of a celeſtial body by taking its diſtance from certain ſtars, and the angle of poſition with regard to them, cannot be expected to give us a compleatly juſt repreſentation of the tract it deſcribes, ſince even the moſt careful obſervations are liable to little errors, both from the remaining imperfections of inſtruments, though they

they ſhould be the moſt accurate that can be had, and from the difficulty of taking angles and poſitions of objects in motion. Add to this a third cauſe of error, namely, the obſcurity of very ſmall teleſcopic ſtars that will not permit the field of view ſo well to be enlightened as we could wiſh, in order to ſee the threads of the micrometer perfectly diſtinct.

This will account for the apparent diſtortions to be obſerved in my figures of the Comet's path. Some little irregularity therein may alſo proceed from different refractions, as they have not been taken into account, though the obſervations have been made at very different altitudes, where conſequently the refractions muſt have been very different. But though this method may be liable to great inconveniences, the principal of which is, that many parts of the heavens are not ſufficiently ſtored with ſmall ſtars to give us an opportunity to meaſure from them, yet the advantages are not leſs remarkable. Thus we ſee that it enabled me to diſtinguiſh the quantity and direction of the motion of this Comet in a ſingle day (from the 18th to the 19th of March) to a much greater degree of exactneſs than could have been done in ſo ſhort a time by a ſector or tranſit inſtrument; nay even an hour or two, we ſee, were intervals long enough to ſhew that it was a moving body, and conſequently, had its ſize not pointed it out as a Comet, the change of place, though ſo trifling as 2¼ ſeconds *per* hour, would have been ſufficient to occaſion the diſcovery. A gentleman very well known for his remarkable ſucceſs in detecting Comets * ſeems to be well aware of the difficulty to diſcover a motion in a heavenly body by the common methods when it is ſo very ſmall; for in a letter he favoured me with, ſpeaking of the Comet, he ſays: "Rien n'etoit plus difficile que de la "reconnoître et je ne puis pas concevoir comment vous avés pu

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* Monſ. MESSIER.

"revenir

" revenir pluſieurs fois ſur cette étoile ou Comête; car abſolu-
" ment il a fallu l'obſerver pluſieurs jours de ſuîte pour s'ap-
" perçevoir qu'elle avoit un mouvement."

I need not ſay that I merely point this out as a temporary advantage in the method I have taken; for as ſoon as we can have regular, conſtant, and long continued obſervations by fixed inſtruments, the excellence of them is too well known to ſay any thing upon that ſubject: for which reaſon I failed not to give immediate notice of this moving ſtar, and was happy to ſurrender it to the care of the Aſtronomer Royal and others, as ſoon as I found they had begun their obſervations upon it.

Deſcription of a micrometer for taking the angle of poſition.

FIG. I. Repreſents the micrometer incloſed in a turned caſe of wood, as it is put together, ready to be uſed with the teleſcope. A is a little box which holds the eye-glaſs. B is the piece which covers the inſide work, and the box A is ſcrewed into it. C is the body of the micrometer containing the braſs work, ſhewing the index plate *a* projecting at one ſide, where the caſe is cut away to receive it. D is a piece, having a ſcrew *b* at the bottom, by means of which the micrometer is faſtened to the teleſcope. To the piece C is given a circular motion, in the manner the horizontal motion is generally given to Gregorian reflectors, by the lower part going through the piece D, where it is held by the ſcrew E, which keeps the two pieces C and D together, but leaves them at liberty to turn upon each other.

Fig. II. Is a ſection of the caſe containing the braſs work, where may be obſerved the piece B hollowed out to receive the

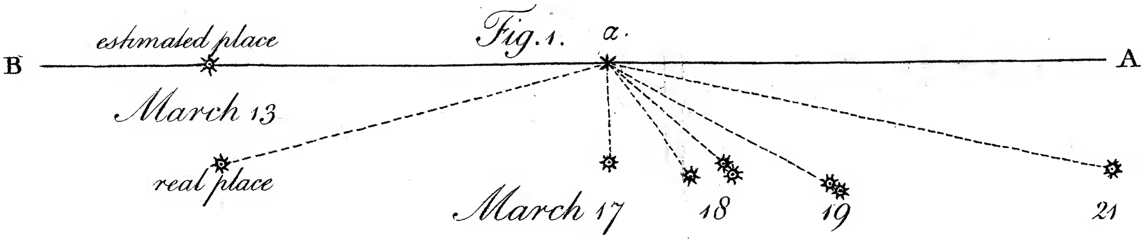


Fig. 1.

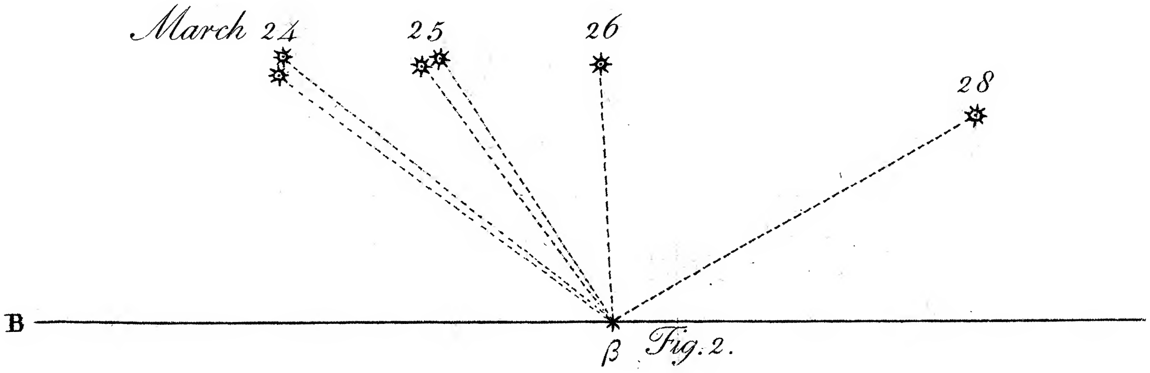
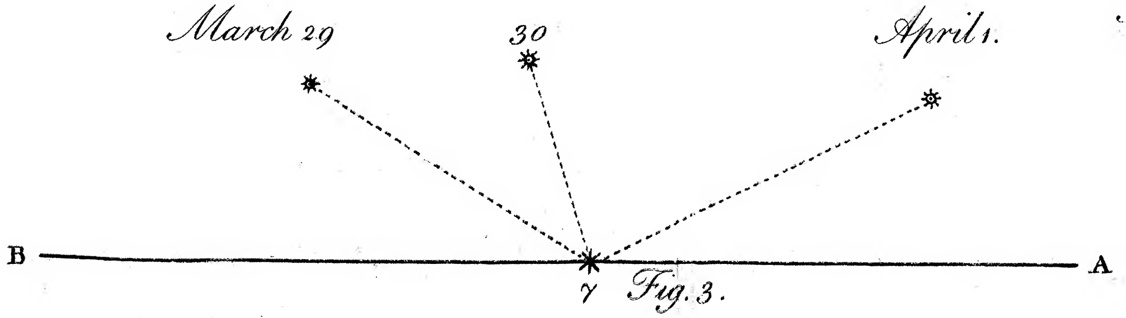


Fig. 2.



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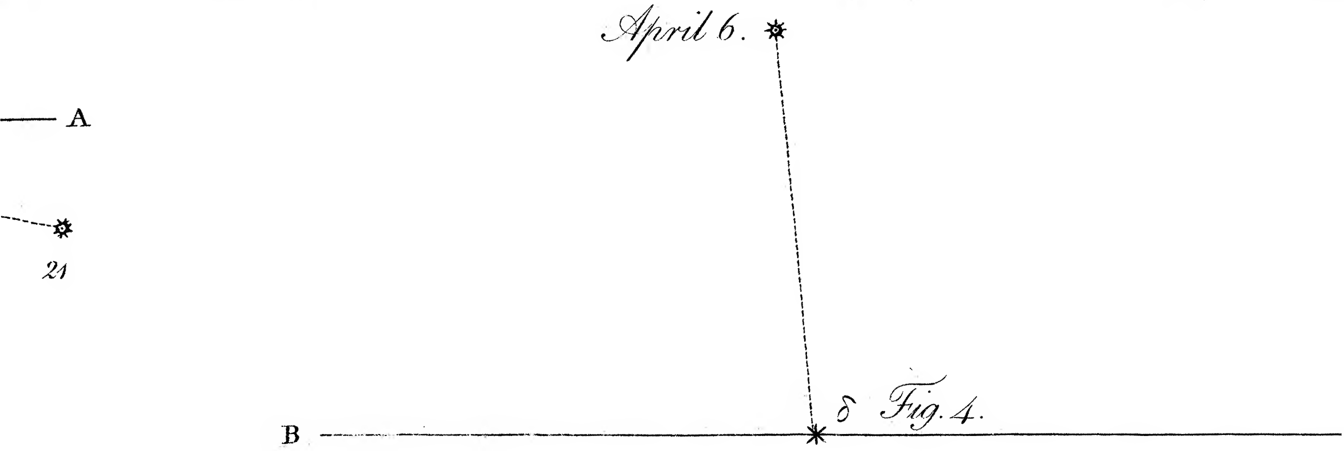

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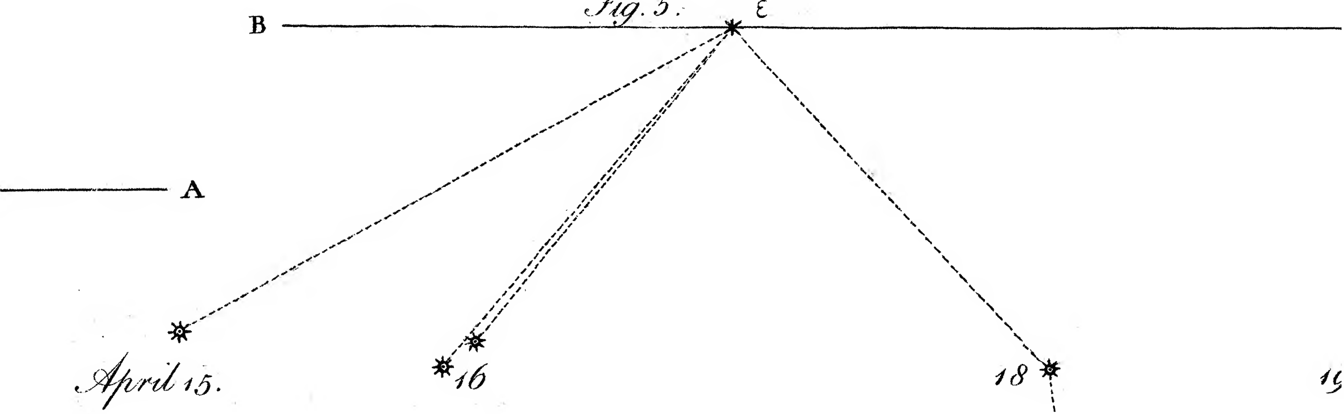

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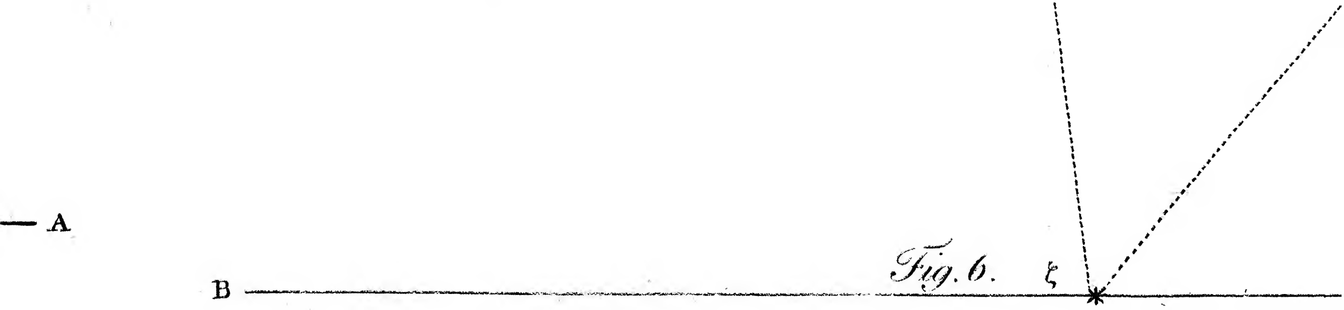

Fig. 6.

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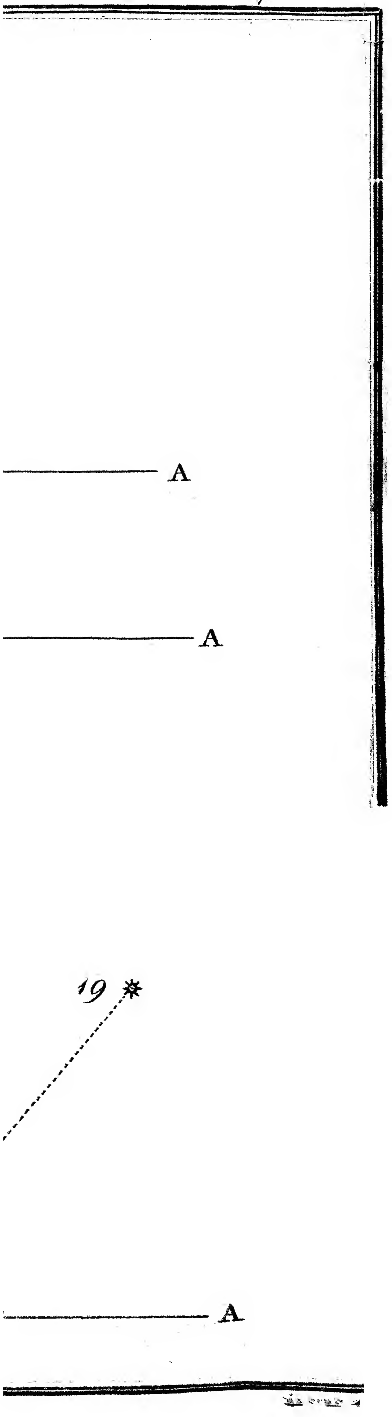
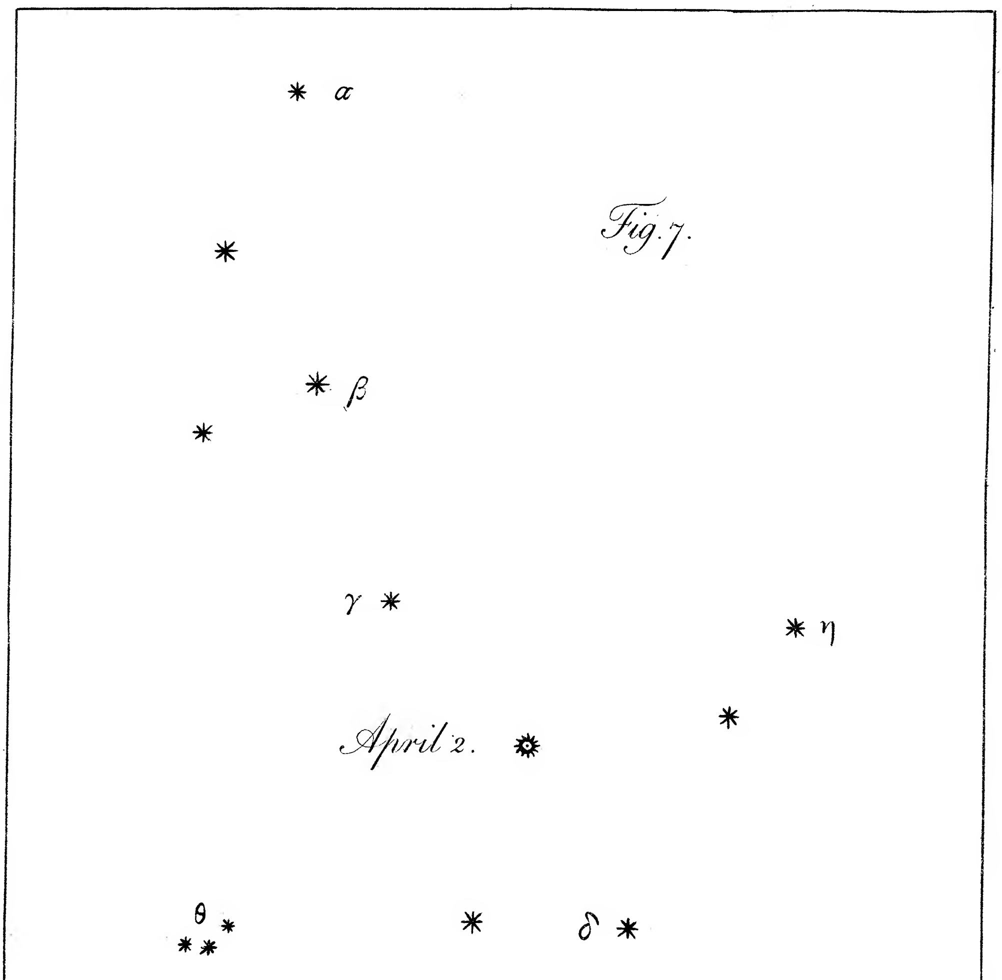
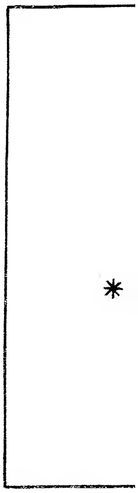


Fig. 7.





April 16.

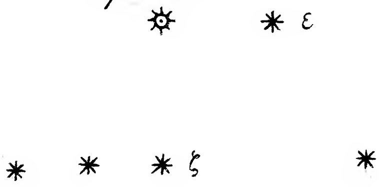


Fig. 8.

Fig. I.

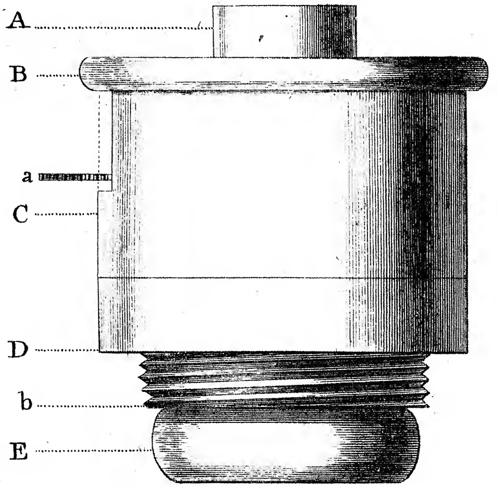


Fig. II.

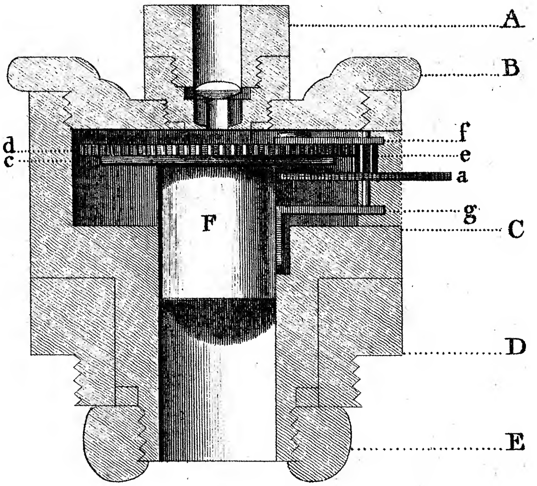


Fig. III.

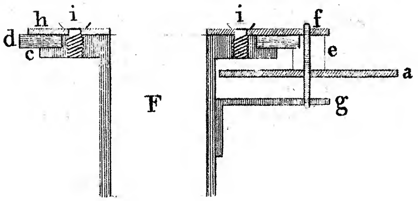
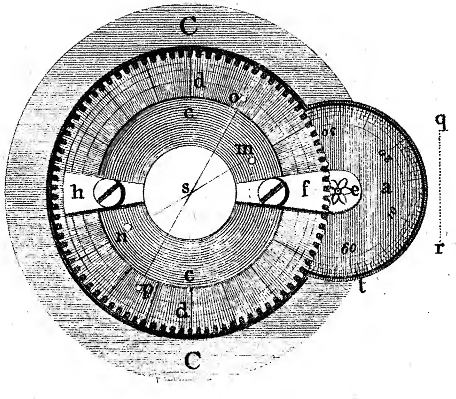


Fig. IV.



box A, which conſiſts of two parts incloſing the eye lens. This figure alſo ſhews how the piece C paſſes through D, and is held by the ring E: the braſs work, conſiſting of a hollow cylinder, a wheel and pinion, and index plate, is there repreſented in its place. F is the body of the braſs work, being a hollow cylinder with a broad rim *c* at the upper end; this rim is partly turned away to make a bed for the wheel *d*. The pinion *e* turns the wheel *d*, and carries the index plate *a*. One of its pivots moves in the arm *f*, ſcrewed upon the upper part of *c*, which arm ſerves alſo to confine the wheel *d* to its place upon *c*. The other pivot is held by the arm *g* faſtened to F.

Fig. III. Is a plan of the braſs work. The wheel *d*, which is in the form of a ring, is laid upon the upper part of F or *c*, and held by two ſmall arms *f* tnd *h*, ſcrewed down to *e* with the ſcrews *i*, *i*.

Fig. IV. Is a plan of the braſs work. *d*, *d*, is the wheel placed upon the bed or ſocket of the rim of the cylinder *c*, *c*, and is held down by the two pieces *f*, *h*, which are ſcrewed upon *c*, *c*. The piece *f* projects over the center of the index plate to receive the upper pivot of the pinion *m*, *n*, is the fixed wire faſtened to *c*, *c*. *o*, *p*, the moveable wire faſtened to the annular wheel *d*, *d*. The index plate *a* is divided into 60 parts, each ſub-divided into two, and milled upon the edge. When the finger is drawn over the milled edge of the index plate from *q* towards *r*, the angle *m*, *s*, *o*, will open, and if drawn from *r* towards *q*, it will ſhut again. The caſe C, C, muſt have a ſharp corner *t*, which ſerves as a hand to poin out the diviſion on the index plate.

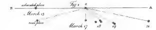
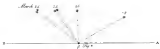


Fig 1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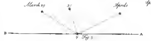


Fig 3

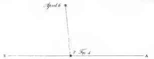


Fig 4

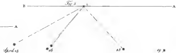
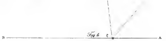


Fig 5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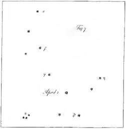

Fig 7

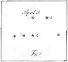

Fig 8